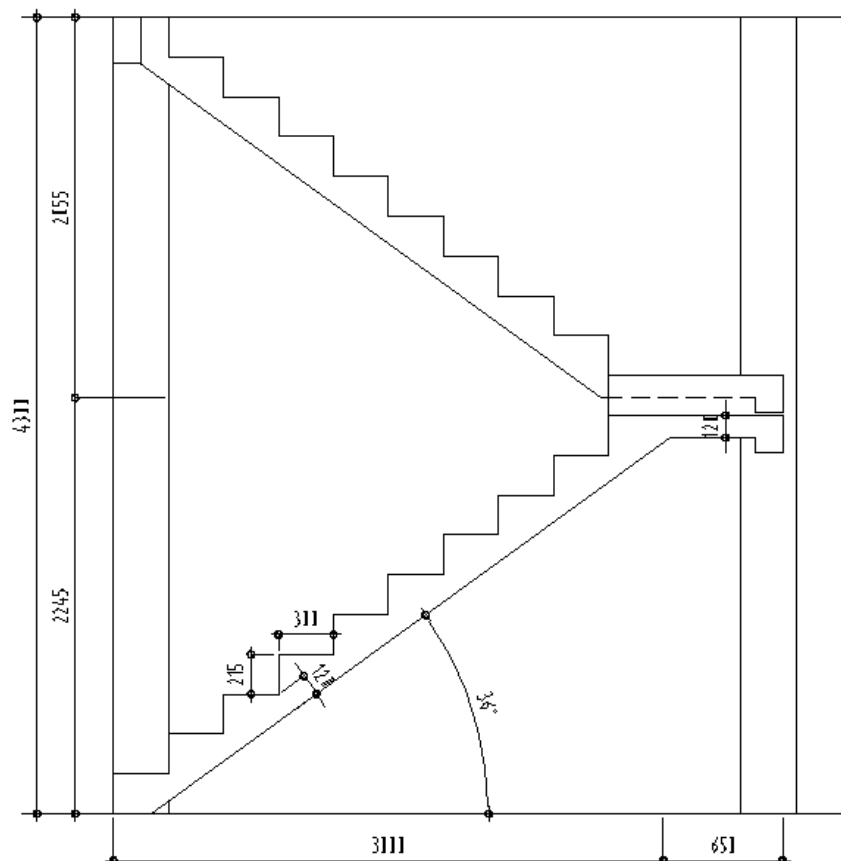


BAB IV PERENCANAAN TANGGA

4.1 Perencanaan Tangga

- Tinggi Lantai $tl := 430 \text{ cm}$
- Tanjakan (t) $t := 21.5 \text{ cm}$
- Injakan (i) $i := 30 \text{ cm}$
- Lebar Tangga $lt := 110 \text{ cm}$
- Tebal Plat Tangga (tp) $tp := 12 \text{ cm}$
- Tebal plat bordes $tpb := 12 \text{ cm}$
- Jumlah tanjakan (nt) $nt := \frac{430}{t} = 20 \text{ tanjakan}$
- Jumlah tanjakan ke bordes $jt := 10 \text{ buah}$
- Lebar bordes $lb := 65 \text{ cm}$
- Panjang bordes $pb := 250 \text{ cm}$
- Panjang horisontal plat tangga $ph := (30 \cdot 10) = 300 \text{ cm}$
- Kemiringan tangga (α) $\text{arc tan } \alpha = \frac{224.5}{300} = 0.748$
 $\alpha = 36^\circ$



4.1.1 Perhitungan Pembebanan Tangga

4.1.1.1 Plat Tangga :

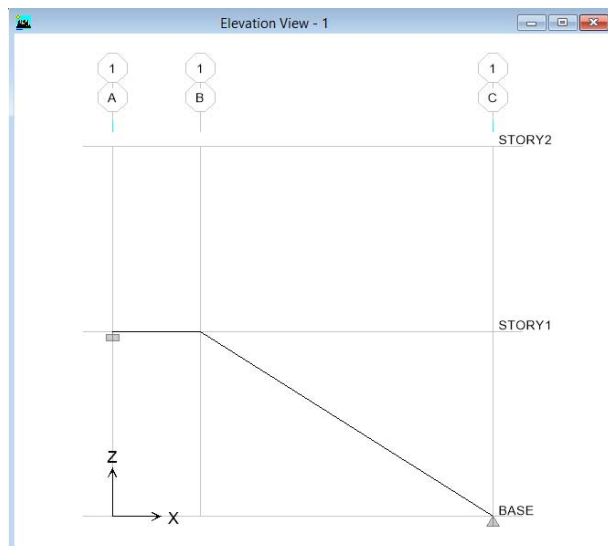
- Beban Mati (qd) :
 - beban sendiri pelat $bsp := \frac{0.12 \cdot 2400}{\cos\left(\frac{\pi}{5.6}\right)} = 340.13 \text{ kg/m}^2$
 - berat ubin (2 cm) $bu := 2 \cdot 24 = 48 \text{ kg/m}^2$
 - berat spesi (2 cm) $bs := 2 \cdot 21 = 42 \text{ kg/m}^2$
 - berat pegangan $bp := 10 \text{ kg/m}^2$
 - $qd := bsp + bu + bs + bp = 440.13 \text{ kg/m}^2$
- Beban Hidup (ql) :
 - beban hidup pada tangga $ql := 300 \text{ kg/m}^2$

4.1.1.2 Plat Bordes :

- Beban Mati
 - Berat sendiri pelat $bsp := 0.12 \cdot 2400 = 288 \text{ kg/m}^2$
 - Berat ubin (2 cm) $bu := 2 \cdot 24 = 48 \text{ kg/m}^2$
 - berat spesi (2 cm) $bs := 2 \cdot 21 = 42 \text{ kg/m}^2$
 - berat pegangan $bp := 10 \text{ kg/m}^2$
 - $qd := bsp + bu + bs + bp = 388 \text{ kg/m}^2$
- Beban Hidup (ql) :
 - beban hidup pada tangga $ql := 300 \text{ kg/m}^2$

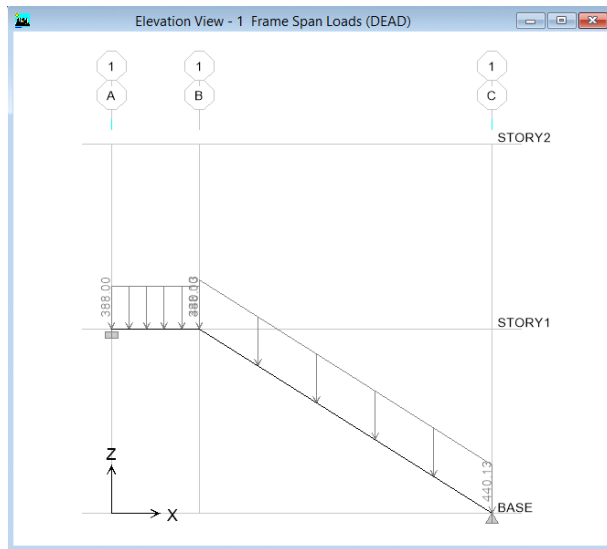
4.1.2 Perhitungan Gaya Dalam

- **Pemodelan Struktur ETABS**

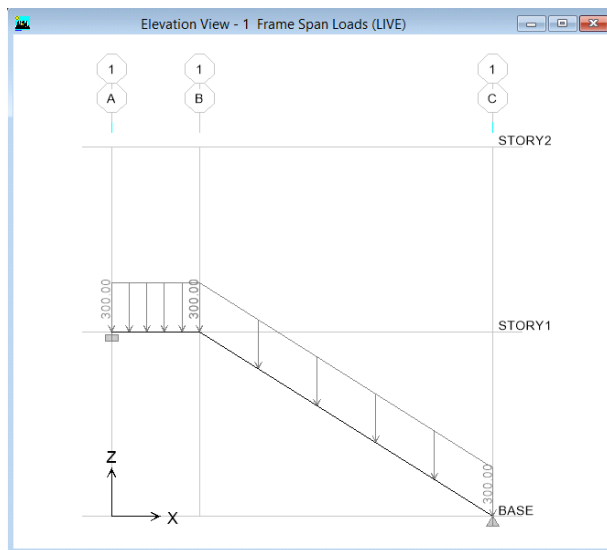


- **Pembebanan Struktur ETABS**

Beban mati

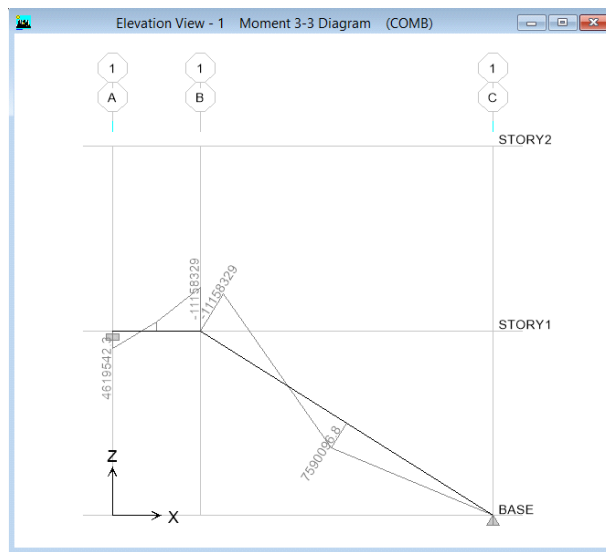


Beban hidup

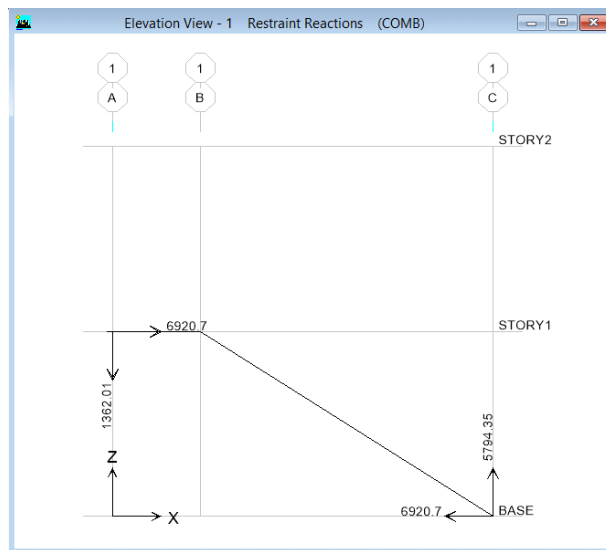


4.1.3 Output Struktur

Bidang Momen



Joint Reaction



Tabel Momen

Story	Brace	Load	Loc	P	V2	M3
STORY1	D1	COMB	0	-8947.02	-1192.25	0
STORY1	D1	COMB	1.776	-7989	320.42	773.974
STORY1	D1	COMB	3.551	-7030.98	1833.09	-1137.83

Joint Reaction

Story	Point	Load	FX	FZ	MY
STORY1	1	COMB	6920.7	-1362.01	471.062
BASE	3	COMB	-6920.7	5794.35	0

4.1.4 Perhitungan Penulangan Tangga

- **Penulangan Lentur Tangga dan Bordes**

Diambil momen yang terbesar yakni :

$$M_u := 1137.83 \text{ kgm}$$

$$f_c := 18.675 \text{ Mpa}$$

$$f_y := 390 \text{ Mpa}$$

$$\beta := 0.85$$

$$\rho_{bal} := \left(\frac{0.85 \cdot \beta \cdot f_c}{f_y} \right) \cdot \left(\frac{600}{600 + f_y} \right) = 0.021$$

$$\rho_{maks} := 0.75 \cdot \rho_{bal} = 0.016$$

$$\rho_{min} := \frac{1.4}{f_y} = 0.004$$

$$m := \frac{f_y}{0.85 \cdot f_c} = 24.569$$

- **Data Pelat Tangga dan Bordes**

Data – data

Tebal pelat : 120 mm

Panjang (b) : 1000 mm (per 1m)

tulangan $\Phi 12$

Tebal selimut beton : 20 mm

$$d_{aksen} := 20 + 0.5 \cdot 12 = 26 \text{ mm}$$

$$d := 120 - d_{aksen} = 94 \text{ mm}$$

- **Perhitungan penulangan lentur**

ambil $\delta := 0.4$

$$M_n := \frac{M_u \cdot 9.81 \cdot 1000}{0.8} = 13952640.375 \text{ Nmm}$$

$$R_n := \frac{(1 - \delta) M_n}{1000 \cdot d^2} = 0.947 \text{ N/mm}^2$$

$$(\rho - \rho_{aksen}) := \frac{\left(1 - \sqrt{1 - \frac{2m \cdot R_n}{f_y}} \right)}{m} = 0.003$$

$$\rho_{aksen} := \frac{\delta \cdot M_n}{f_y \cdot (d - d_{aksen}) \cdot 1000 \cdot d} = 0.002$$

$$\rho := 0.003 + 0.002 = 0.005 \quad \blacksquare > \blacksquare \quad \rho_{min} = 0.0036$$

$$\rho = 0.005 < \rho_{\text{maks}} = 0.016$$

$$A_{\text{perlu}} := \rho \cdot 1000 \cdot d = 470 \text{ mm}^2$$

Pasang $\Phi 12 - 150$

$$A_{\text{psg}} := 0.785 \cdot 12^2 \cdot 7 = 791.28 \text{ mm}^2 \quad \blacksquare > \blacksquare \quad A_{\text{perlu}} = 470 \text{ mm}^2$$

• **Tulangan Pembagi**

Tulangan pembagi diambil 30 % tulangan utama

$$A_{\text{sb}} := 0.3 \cdot A_{\text{psg}} = 237.384 \text{ mm}^2$$

Pasang $\Phi 12 - 150$

$$A_{\text{p}} := 7 \cdot 0.785 \cdot 12^2 = 791.28 \text{ mm}^2 \quad \blacksquare > \blacksquare \quad A_{\text{sb}} = 237.384 \text{ mm}^2$$